

**APPARATUS AND METHOD FOR RECEIVING TELEVISION AND
RADIO BROADCASTING SIGNALS USING A SINGLE TUNER**

BACKGROUND OF THE INVENTION

[01] This application claims the priority of Korean Patent Application No. 2002-67397, filed on November 1, 2002, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

1. Field of the Invention

[02] The present invention relates to a combined TV (television) and FM (frequency modulation) radio receiver and a method to receive TV and FM radio signals, and more particularly, to a combined TV and FM radio receiver capable of, and a method for, selectively receiving TV and FM radio signals via a single tuner using a digital IF (intermediate frequency) stage.

2. Description of the Related Art

[03] A TV receiver for receiving broadcasting signals, e.g., TV signals and FM radio signals, transmitted in different frequency bands typically includes a plurality of tuners in correspondence with the respective frequency bands and a plurality of detection circuits for detecting signals selected via the respective tuners.

[04] FIG. 1 is a block diagram of a conventional combined TV and FM radio receiver. Referring to FIG. 1, a TV tuner 110 converts TV signals received via an antenna into IF signals. A video band filter 112 extracts video band signals from the IF signals output from the TV tuner 110. A video IF converter 116 converts the video signals extracted by the video band filter 112 into video baseband signals. A video demodulator 120 extracts composite video baseband signals (CVBS) from the baseband signals output from the video IF converter 116. A video processor 122 converts the composite video baseband signals extracted by the video demodulator 120 into red (R), green (G), and blue (B) color signals and outputs them via a CRT (cathode ray tube) 124.

[05] An audio band filter 114 extracts audio band signals from the IF signals output from the TV tuner 110. An audio IF converter 118 converts the audio signals extracted by the audio band filter 114 into audio baseband signals.

[06] Meanwhile, a radio tuner 132 receives FM radio signals via another antenna. An amplifier 134 amplifies the FM radio signals received via the radio tuner 132. A radio IF converter 136 converts the FM radio signals amplified via the amplifier 134 into IF band signals. An audio demodulator 142 extracts and demodulates audio signals from the audio baseband signals extracted by the audio IF converter 118 and the IF band signals extracted by the IF converter 136. A sound processor 144 amplifies the audio signals

demodulated by the audio demodulator 142 and outputs them via a speaker 146.

[07] As described above, the conventional combined TV and FM radio receiver has required not only a TV tuner but also a separate radio tuner and other radio signal processing elements, such as an amplifier, a radio IF converter, etc. Accordingly, the structure of the conventional receiver is complex and the production cost thereof is high.

SUMMARY OF THE INVENTION

[08] The present invention provides a combined TV and FM radio receiver capable of receiving TV signals as well as FM radio signals via a single unit in which conventional elements, such as a TV tuner, a radio tuner, IF converts for TV signals, and a radio IF converter, are integrated so that the production cost of the receiver can be lowered and the usability thereof can be improved.

[09] According to an aspect of the present invention, there is provided a combined TV (television) and FM (frequency modulation) radio receiver, comprising: a tuner that selects TV band or FM radio band signals and converts the selected TV band signals or FM radio band signals into IF signals and/or primary sound IF signals; an IF (intermediate frequency) processor that generates different local oscillating signals depending on whether a current mode is a TV mode or an FM radio mode, and converts the IF signals and/or primary sound IF signals, which are converted by the tuner, into base band signals and secondary sound IF signals, respectively; a video demodulator that extracts video signals from the IF band signals processed via the IF processor;

an audio demodulator that extracts either TV audio signals or FM radio signals from the baseband signals and/or secondary sound IF signals processed via the IF processor according to a TV sound or FM radio mode data; and a controller that controls the selection of the tuner based on TV channel selection data or FM radio channel selection data, controls the IF processor to generate different local oscillating frequency depending on whether a current mode is a TV mode or an FM radio mode, and applies the TV sound or FM radio mode data to the audio demodulator.

BRIEF DESCRIPTION OF THE DRAWINGS

[10] The above and other aspects and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[11] FIG. 1 is a block diagram of a conventional combined TV and FM radio receiver;

[12] FIG. 2 is a block diagram of a combined TV and FM radio receiver using a single tuner according to an embodiment of the present invention;

[13] FIG. 3 is a more detailed block diagram of the digital IF processor shown in FIG. 2;

[14] FIG. 4A shows signals to be filtered by the bandpass filter shown in FIG. 3 and FIG. 4B shows signals to be filtered by the digital filter shown in FIG. 3; and

[15] FIG. 5 shows an example of a TV screen when a user selects an FM radio mode.

DETAILED DESCRIPTION OF THE INVENTION

[16] An exemplary embodiment of the present invention will now be described with reference to FIGS. 2 through 5.

[17] FIG. 2 is a block diagram of a combined TV and FM radio receiver using a single tuner according to the present invention. Referring to FIG. 2, a tuner 210 selects TV band signals and/or FM radio band signals according to a channel selection signal output from a controller 280 and converts RF TV and/or FM radio band signals received via an antenna into IF signals. For example, in a TV mode, RF signals in a frequency band of 500-800 MHz are converted into 38.9 MHz signals that correspond to video IF signals. Also, in a FM radio mode, the RF signals in a frequency band of 88-108 MHz are converted into 33.4 MHz signals that correspond to primary sound IF band signals.

[18] A SAW (surface acoustic wave) filter 220 filters TV video/sound band signals and FM sound band signals from the IF signals converted output from the tuner 210. Here, the SAW filter 220 has a broader filtering band, e.g., 8 MHz, than a filter used in a conventional TV receiver to sufficiently cover the TV video/sound band signals and FM sound band signals.

[19] A digital IF processor 230 converts the filtered IF signals output from the SAW filter 220 into baseband signals and secondary sound IF band (SIF) signals, in response to a control signal that is differently generated by the controller 280 depending on whether a current mode is a TV mode or a FM radio mode. For example, in a case of a PAL-I system, the IF signals at 38.9

MHz output from the tuner 210 are applied to the digital IF processor 230 and are converted into baseband signals having a bandwidth of 8 MHz via the digital IF processor 230. Also, in the FM radio mode, the digital IF processor 230 converts the primary sound IF signals into 5.5 MHz signals that correspond to secondary sound IF band signals, irrespective of whether an input signal is an FM radio signal or a TV sound signal.

[20] A video demodulator 240 extracts composite video baseband signals (CVBS) from the baseband signals output from the digital IF processor 230. A video processor 250 converts the composite video baseband signals extracted by the video demodulator 240 as well as on-screen display (OSD) signals, such as, background image signals or radio output message signals, produced via the controller 280 into R, G, and B color signals and outputs them via a CRT 255.

[21] An audio demodulator 260 extracts TV audio signals or radio audio signals from the sound IF signals output from the digital IF processor 230 according to a TV or radio sound mode output from the controller 280. For example, the TV sound IF signals are converted into the baseband signals via quadrature demodulation and the FM sound IF signals are converted into the baseband signals via an FM PLL (phase locked loop) demodulation. In particular, the audio demodulator 260 extracts the TV audio signals or radio audio signals from the sound IF signals, in a secondary sound IF band, that is output from the digital IF processor 230.

[22] A sound processor 270 amplifies the audio signals demodulated by the audio demodulator 260 and outputs them via a speaker 290.

[23] The controller 280 stores TV band channel selection data and FM radio band channel selection data. When a key signal corresponding to a channel selection instruction is received via a remote control (not shown), the controller 280 provides the channel selection data in a channel selection signal, and frequency control data in a frequency control signal to the tuner 210 and the digital IF processor 230, respectively. Further, the controller 280 applies a TV sound mode instruction or a radio mode instruction to the audio demodulator 260 according to the sound mode selected by a user so that the audio demodulation suitable for the selected sound mode can be performed. In addition, when a FM radio mode instruction is received from the user, the controller 280 outputs the background image data signals or radio output message data signals via the video processor 250 and controls the tuner 210 to receive FM radio signals. For example, when the FM radio mode is set by the user, the controller 280 produces predetermined OSD (on-screen display) information on the corresponding channel, which is displayed on a TV screen as shown in FIG. 5.

[24] FIG. 3 is a more detailed block diagram of the digital IF processor 230 shown in FIG. 2. Referring to FIG. 3, a local oscillator 310 generates oscillating signal suited for a TV system, e.g., PAL-I, PAL/SECOM B/G, or NTSC, or an FM radio according to frequency control signals produced by the controller 280. A mixer 320 mixes the oscillating frequency generated by the

local oscillator 310 with the filtered IF signals output from the SAW filter 220. For, example, the mixer 320 outputs 8 MHz signals by mixing 38.9 MHz IF signals with 30.9 MHz oscillating signals in the PAL-I system, 7 MHz signals by mixing 38.9 MHz IF signals with 31.9 MHz oscillating signals in the PAL/SECAM B/G system, and 6 MHz signals by mixing 38.9 MHz IF signals with 32.9 MHz oscillating signals in the NTSC system. Also, when a sound signal is input to the mixer 320, the mixer 320 outputs 5.5 MHz signals, which correspond to secondary SIF band signals, by mixing 33.4 MHz IF signals in a primary SIF band with 27.9 MHz oscillating signals. The secondary SIF band signals are output directly to the audio demodulator 260.

[25] A bandpass filter 330 blocks adjacent channel signals 410 and noise signals among the baseband signals output from the mixer 320 and has it so that only baseband signals 420 corresponding to the selected channel via the tuner 210 passes, as shown in FIG. 4A. Accordingly, the bandpass filter 330 has it so that only the IF signals of the corresponding channel pass.

[26] An analog-to-digital converter (ADC) 342 converts the analog baseband signals output from the bandpass filter 330 into digital baseband signals.

[27] A digital filter 344 separates the digital baseband signals output from the ADC 342 into video signals 440 and sound signals 430, as shown in FIG. 4B, using a predetermined digital filtering algorithm. Here, the digital filtering algorithm extracts required characteristics by processing the digital IF signals via adequate operations, such as, adding, multiplying, delaying, etc.,

according to filtering coefficients applied from the controller 280. A first digital-to-analog converter (DAC) 346 converts the digital video signals output from the digital filter 344 into analog video signals and a second DAC 348 converts the digital sound signals output from the digital filter 344 into analog sound signals.

[28] As described above, according to the present invention, since TV signals and FM radio signals can be selectively received using a single tuner, production cost can be saved while usability can be improved. Further, when an FM radio signal is input, it is possible to produce secondary sound IF signals using a primary sound IF component, without a video IF component.

[29] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the appended claims.